Problem 2 (6 Points)

In this problem you'll learn how to make a 'pipeline' in SciKit-Learn. A pipeline chains together multiple sklearn modules and runs them in series. For example, you can create a pipeline to perform feature scaling and then regression. For more information see https://machinelearningmastery.com/standardscaler-and-minmaxscaler-transforms-in-python/

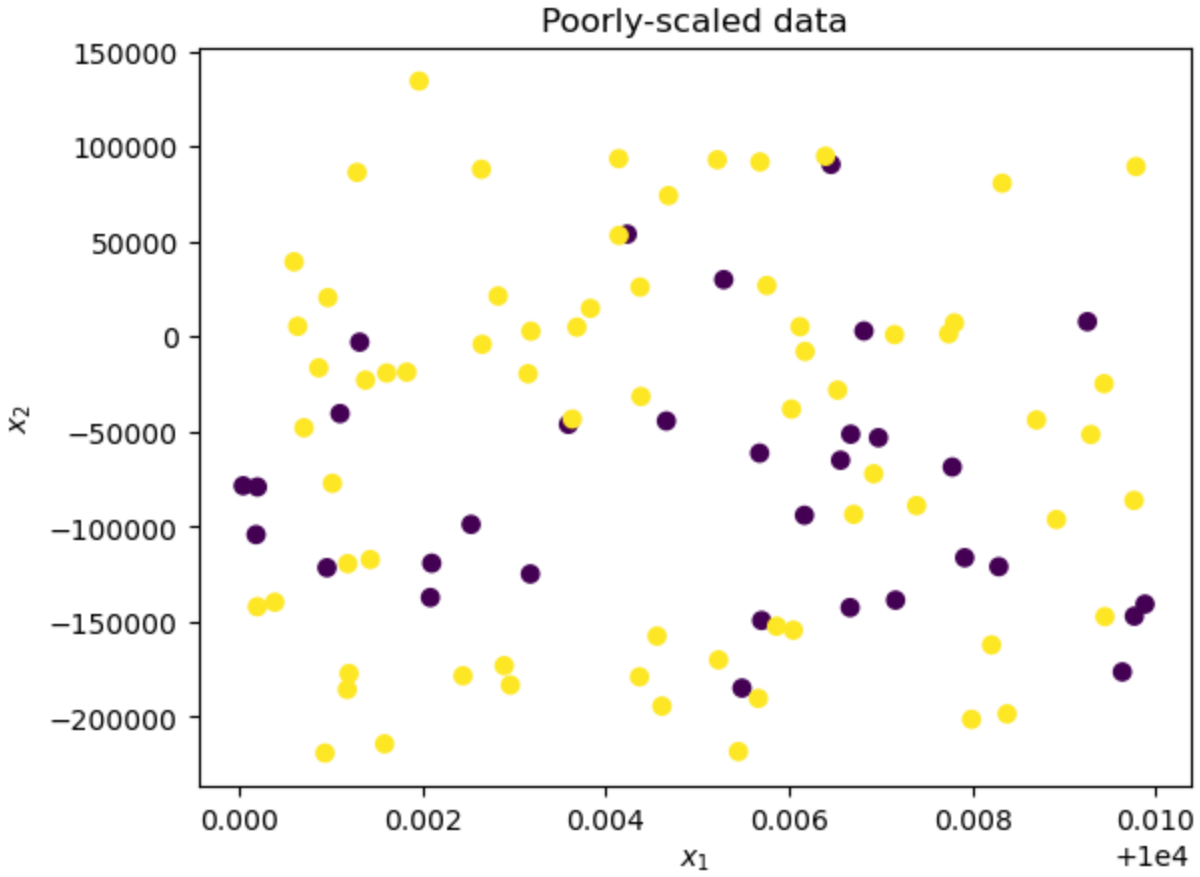
First, run the cell below to import modules and load data. Note the data axis scaling.

In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
from sklearn.pipeline import Pipeline
from sklearn.preprocessing import StandardScaler, MinMaxScaler
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC
from sklearn.linear_model import LogisticRegression

x1 = np.array([10000.00548814, 10000.00715189, 10000.00602763, 10000.00544883, 10000.00423655, 10000.00645894, 10000.00
x2 = np.array([-184863.4856705 ,    1074.38382588,  -38090.38042426, -218261.93176495,   53942.6974416 ,   90630.025842
X = np.vstack([x1,x2]).T
y = np.array([0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0,

X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=0, train_size=0.8)

plt.figure()
plt.scatter(x1,x2,c=y,cmap="viridis")
plt.xlabel("$x_1$")
plt.ylabel("$x_2$")
plt.title("Poorly-scaled data")
plt.show()
```



Creating a pipeline

In this section, code to set up a pipeline has been given. Make note of how each step works:

1. Create a scaler and classifier
2. Put the scaler and classifier into a new pipeline
3. Fit the pipeline to the training data
4. Make predictions with the pipeline

In [12]:
```
# Create a scaler and a classifier
scaler = MinMaxScaler()
model = KNeighborsClassifier()
```

```
# Put the scaler and classifier into a new pipeline
pipeline = Pipeline([("MinMax Scaler", scaler), ("KNN Classifier", model)])

# Fit the pipeline to the training data
pipeline.fit(X_train, y_train)

# Make predictions with the pipeline
pred_train = pipeline.predict(X_train)
pred_test = pipeline.predict(X_test)
print("Training accuracy:", accuracy_score(y_train, pred_train),
      "   Testing accuracy:", accuracy_score(y_test, pred_test))
```

```
Training accuracy: 0.825    Testing accuracy: 0.6
```

Testing several pipelines

Now, complete the code to create a new pipeline for every combination of scalers and models below:

Scalers:

- None
- MinMax
- Standard

Classifiers:

- Logistic Regression
- Support Vector Machine
- KNN Classifier, 1 neighbor

Within the loop, a scaler and model are created. You will create a pipeline, fit it to the training data, and make predictions on testing and training data.

In [21]:
```
def get_scaler(i):
    if i == 0:
        return ("No Scaler", None)
    elif i == 1:
        return ("MinMax Scaler", MinMaxScaler())
    elif i == 2:
        return ("Standard Scaler", StandardScaler())
```

```
def get_model(i):
    if i == 0:
        return ("Logistic Regression", LogisticRegression())
    elif i == 1:
        return ("Support Vector Classifier", SVC())
    elif i == 2:
        return ("1-NN Classifier", KNeighborsClassifier(n_neighbors=1))

for scaler_index in range(3):
    for model_index in range(3):
        scaler = get_scaler(scaler_index)
        model = get_model(model_index)

        # YOUR CODE GOES HERE
        # Create a pipeline
        # Fit the pipeline on X_train, y_train
        # Calculate acc_train and acc_test for the pipeline

        pipeline = Pipeline([scaler,model])
        pipeline.fit(X_train,y_train)

        pred_train = pipeline.predict(X_train)
        acc_train = accuracy_score(y_train,pred_train)

        pred_test = pipeline.predict(X_test)
        acc_test = accuracy_score(y_test,pred_test)

        print(f"{scaler[0]:>15},{model[0]:>26}: Train Acc. = {100*acc_train:5.1f}%  Test Acc. = {100*acc_test:5.1f}% ")
```

```
      No Scaler,       Logistic Regression: Train Acc. =  67.5%  Test Acc. =  70.0%
      No Scaler, Support Vector Classifier: Train Acc. =  78.8%  Test Acc. =  65.0%
      No Scaler,           1-NN Classifier: Train Acc. = 100.0%  Test Acc. =  50.0%
  MinMax Scaler,       Logistic Regression: Train Acc. =  67.5%  Test Acc. =  70.0%
  MinMax Scaler, Support Vector Classifier: Train Acc. =  67.5%  Test Acc. =  70.0%
  MinMax Scaler,           1-NN Classifier: Train Acc. = 100.0%  Test Acc. =  85.0%
Standard Scaler,       Logistic Regression: Train Acc. =  67.5%  Test Acc. =  70.0%
Standard Scaler, Support Vector Classifier: Train Acc. =  68.8%  Test Acc. =  70.0%
Standard Scaler,           1-NN Classifier: Train Acc. = 100.0%  Test Acc. =  85.0%
```

Questions

Answer the following questions:

1. Which model's testing accuracy was improved the most by scaling data?

   1-NN Classifier was improved the most by scaling data

2. Which performs better on this data: MinMax scaler, Standard scaler, or neither?

   Neither of them are better on this data as both MinMax scaler and Standard scaler gives the same accuracy on the testing data
   Neither both gave the same accuracy. A very slight difference in training data.

In [ ]: